An Interdisciplinary Analysis of Multispectral Satellite Data for Selected Cover Types in the Colorado Mountains, Using Automatic Data Processing Techniques

EREP S398

Monthly Progress Report for April 1975

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MONTHLY PROGRESS REPORT

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A. Overall Status and Progress to Date

Two proposal extensions were submitted to NASA/JSC during the month. The first was for an extension of our present research contract for the period 1 June 1975 to 30 September 1975 for a total amount of $23,661. This proposal, if accepted, will enable us to complete our research objectives as outlined in the Statement of Work and also to throughly document all existing research results. The second proposal extension is to enable Dr. Hoffer to act as an editor for compiling the final EREP report for the Regional Planning and Cartography Division. This proposal extension is for the period June 1, 1975 through June 30, 1976 and requests $18,370.

Detailed analysis of the June 5, 1973, S-192 data continued. Nine training areas (each 40x40 pixels) were used with a modified clustering technique to develop the training statistics. The complexity of the test site led to 135 individual cluster classes for the nine training areas. Seven wavelength band were used throughout the analysis (bands 2,3,7,9,11,12, and 13). The separability algorithm was used to pool the similar cluster classes with a minimum separability (transformed divergence) of 1500. The statistics for the 135 cluster classes could then be pooled into 97 spectral classes that had a separability value greater than 1500. This analysis is continuing in order to reduce the number of spectral classes and to increase the minimum separability to at least 1700.

A preliminary evaluation of the various channels of a multiple source data tape was also accomplished in the past month. As previously reported, this data tape consists of four channels of LANDSAT-1 data, 13 channels of Skylab S-192 data, and one channel containing elevation. The average saturating transformed divergences were calculated for each channel using statistics from the previously selected list areas, which largely consist of areas of forest species. The results indicate that the near infrared region has the highest information content to separate the various cover types (Table 1). There are seven near infrared channels (two LANDSAT-1 and five Skylab) on the tape and these channels were the seven best spectral channels. The best channels are very close in their separability values, indicating that all contain about the same quantity of information. Elevation, one of the best five, contains about the same quantity of of information, thus indicating that elevation may significantly increase classification accuracy. One

important note is that the lowest four channels according to the divergence values had significant amounts of noise. Therefore the spectral region represented by these channels may not be as bad as indicated in Table 1 (i.e. there may be significant spectral information content in these channels but it is being masked by the noise in this particular data set).

A third phase of work this past month involved a preliminary analysis of the relationships between spatial characteristics of the data and classification accuracy. In this sequence, three different classification algorithms were applied to the existing test areas. The first classification system involved the use of the standard Per Point classification algorithm, whereby each resolution element is classified independently. The second classification system involved the LARSYS "sample" classification algorithm which used the spatial variance of only the pixels in the test area designated by the analyst (in this case, each test area contained 16 pixels.) All off the pixels in one area are classified as a group into one training class. The third classification system involved a computer boundary finding algorithm which splits the study site into spectrally similar areas, and then classifies each area as a unit, using a procedure very similar to the sample classification described above.

The test areas were divided into 12 cover type classes (Table 2). Statistics were calculated for each class and then used to train the classification algorithms. The classification accuracy for each cover type for each classification algorithm is shown in Table 2. A preliminary evaluation indicates that the boundary finding sample classifier gives the highest overall classification accuracy, and in all except a few classes, gives a higher classification accuracy than the perpoint classifier.

TABLE I

TEST FIELD STATISTICAL EVALUATION

RANK	CHANNEL	SOURCE	WAVELENGTH	REGION	DATA QUALITY	AVERAGE SATURATING TRANSFORMED DIVERGENCE
1	8	Skylab	0.98-1.08	near IR	fair	1311
2	7	LANDSAT	0.80-1.10	near IR	good	1305
3	18	DMA	Elevation	-		1302
4	9	Skylab	1.09-1.19	near IR	good	1299
5	6	LANDSAT	0.70-0.80	near IR	good	1296
6	7	Skylab	0.78-0.88	near IR	good	1227
7	10	Skylab	1.20-1.30	near IR	fair	1057
8	6	Skylab	0.68-0.76	near IR	fair	1036
9	11	Skylab	1.55-1.75	middle IR	good	860
10	4	LANDSAT	0.50-0.60	visible	good	820
11	5	LANDSAT	0.60-0.70	visible	good	766
12	3	Skylab	0.52-0.56	visible	good	619
13	2	Skylab	0.46-0.51	visible	good	598
14	12	Skylab	2.10-2.35	middle IR	fair	579
15	13	Skylab	10.20-12.50	thermal	poor	569
16	4	Skylab	0.56-0.61	visible	poor	555
17	5	Skylab	0.62-0.67	visible	poor	471
18	1	Skylab	0.41-0.46	visible	poor	416

TABLE II

Classification Algorithm Performance

TYPE	CLASSIFY POINTS	SAMPLE CLASSIFY	BOUNDARY FINDING SAMPLE CLASSIFY
Water	99.3	100.0	98.7
Snow	100.0	100.0	99.8
Oak	71.5	91.3	91.8
Pasture	65.2	100.0	82.1
Agriculture	77.1	83,3	45.8
Aspen	46.9	50.0	60.2
Ponderosa Pine	60.7	73.8	58.3
P. Pine/Doug. fir	51.7	66.7	58.7
Engelmann Spruce	45.9	51.4	70.6
Douglas fir	6.7	13.7	9.9
Doug. fir/Aspen	16.4	27.5	34.8
Engel. Spruce/Aspen	22.2	36.4	31.8
OVERALL	37.3	47.3	48.1

During the past month the watershed for Lemon Reservoir was delineated by using the Lemon Reservoir, Vallecito Reservoir, Needle Mtns. S.E. and Needle Mtns. S.W. 7 1/2 minute quadrangles. At the present time, we are outlining the watershed boundaries on the multichannel data set that contains the four LANDSAT-1 bands, the 13 SKYLAB-2 bands and the topographic information. The next step will consist of performing a multichannel classification of the area within the Lemon Reservoir watershed in order to map the areal extent of the snowpack within the irregularly shaped watershed area. The results of this part of the investigation will be reported in the next monthly progress report.

Overlay of the SL-2 and SL-3 SKYLAB MSS data and topographic data was completed in April. Several data sets were generated containing various combinations of channels from different times, because it is undesirable to have all channels in the same data set due to the large record size produced. All channels from all types of the data are registered to the same ERTS reference. Thus any combination of registered channels can be created by simply extracting the data from the separate runs and combining them in a single data set. A complete listing of the runs will be made for the final report.

Slope and aspect angles calibrated in degrees have been computed and included with the topographic elevation channel. Software was developed to do this as part of the project. This work completes the overlay project for the contract.

B. Recommendations

None

C. Expected Accomplishments

Analysis of the S192 Data is proceeding at a quickening pace. Results of the research projects are currently being evaluated and documentations. A detailed outline of the final report will be completed in the next month.

D. Significant Results

There are no author-identified significant results in this report.

E. Travel

There were no travel funds expended during this reporting period for this contract.